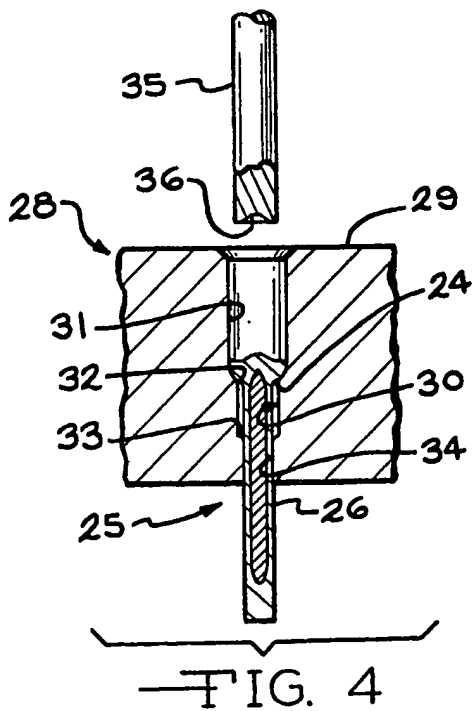


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(54) Production of spark plug electrodes

(57) A lower portion (26) of an extruded composite electrode blank (25) is inserted into a die (29) having a stepped bore (30) including an upper bore (31), a shearing shoulder (32) of reduced diameter equal to that of the desired electrode head configuration, a second shoulder (33) and a lower

bore (34). The upper headed portion (24) and the lower portion (26) of the electrode blank (25) fit closely within the upper and lower bores (31, 34), respectively. The upper headed portion (24) of the electrode blank (25) is then forced past the shearing shoulder (32) and against the second shoulder (33) by a plunger (35) to form the desired electrode head configuration.



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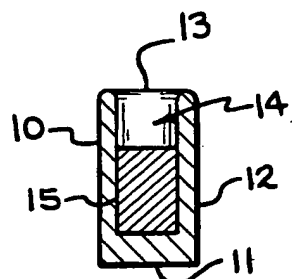


FIG. 1

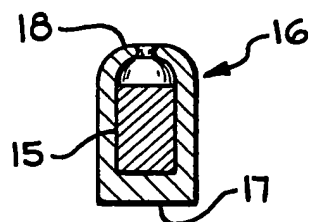


FIG. 2

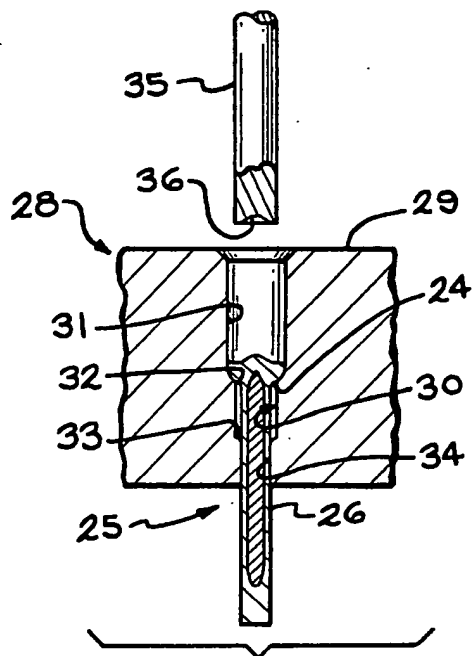


FIG. 4

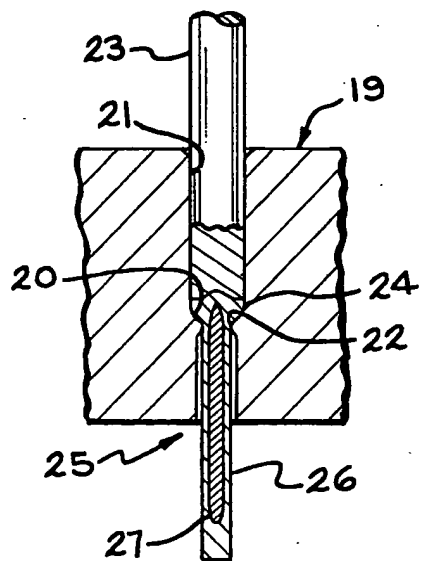


FIG. 3

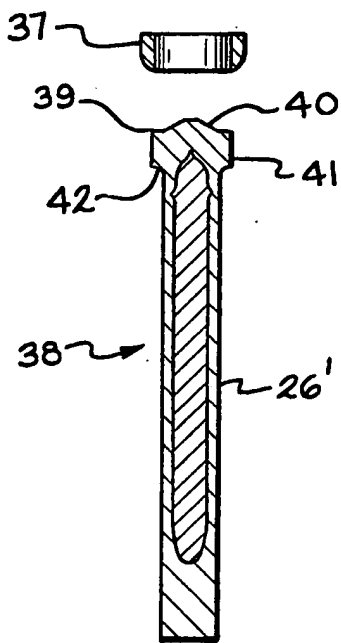


FIG. 5

SPECIFICATION

Production of spark plug electrodes

This invention relates to an improved method for producing a composite centre electrode for a spark plug.

Methods for producing composite centre electrodes have previously been known. Referring to Figure 1, one such method involves first forming a cup 10 from a corrosion-resistant metal, such as nickel. The cup 10 has a closed end 11, walls 12 extending upwardly from the closed end 11 to an open end 13 and a cavity 14 extending concentrically therein. A close-fitting right circular cylindrical billet 15 of a metal having a high thermal conductivity, e.g., copper, is positioned inside the cup 10. The billet 15 fits tightly within the cup walls 12 adjacent the closed cup end 11, but terminates short of the open cup end 13 so that the cup walls 12 extend thereabove at the end 13. A composite billet 16 having closed and filled ends 17 and 18 (see Figure 2) is then formed by rolling the cup walls 12 adjacent the end 13 radially inwardly to substantially enclose the billet 15. The method further involves inserting the closed end 17 of the composite billet 16 into a die 19 (Figure 3) having a stepped bore 20 including an upper bore 21 in which the billet 16 fits closely and an extrusion orifice 22 of reduced diameter relative to the upper bore 21. Pressure is then applied to a plunger 23 to force all except a terminal portion 24 of the billet 16 through the extrusion orifice 22. An electrode blank 25 thus formed has the unextruded terminal portion 24 as an upper headed portion, a lower portion 26 of reduced diameter extending longitudinally therefrom, and a copper core 27 extending therein. After the electrode blank 26 is removed from the die 19, it is suitable for use as a composite centre electrode for a spark plug. If desired, however, the upper headed portion 24 can be shaped by cold-working or further extrusion into a more desirable electrode head configuration.

It is an object of the invention to provide a method for producing a composite centre electrode for a spark plug in which an upper headed portion of an electrode blank is sheared to form a desired electrode head configuration.

The present invention consists in a method for producing a composite centre electrode for a spark plug, which method comprises the steps of forming a corrosion-resistant metal cup having a closed end, walls extending upwardly from the closed end to an open end and a cavity extending concentrically therein, forming a composite billet having closed and filled ends by inserting into the open end of the cup a close-fitting right circular cylindrical billet of a metal having a high thermal conductivity and fitting tightly within the cup walls adjacent the closed cup end, but terminating short of the open cup end so that the cup walls extend thereabove at the open cup end, and by rolling the cup walls adjacent the open cup end radially inwardly, inserting the closed end of the

composite billet into a die having a stepped bore including an upper bore in which the billet fits closely and an extrusion orifice of reduced diameter, forcing all except a terminal portion adjacent the filled end of the composite billet through the extrusion orifice to form an electrode blank having the unextruded terminal portion as an upper headed portion and a lower portion of reduced diameter extending longitudinally therefrom, removing the electrode blank from the bore, and shaping the upper headed portion of the electrode blank into a desired electrode head configuration to form the composite electrode; the improvement wherein the lower portion of the electrode blank is inserted into a die having a stepped bore including an upper bore in which the upper headed portion of the electrode blank fits closely, a shearing shoulder of reduced diameter equal to that of the desired maximum electrode head diameter, a second shoulder and a lower bore in which the lower portion of the electrode blank fits closely, and the headed portion of the electrode blank is then forced past the shearing shoulder and against the second shoulder to remove the excess material from the head and to form the desired electrode head configuration in a single forming operation.

In the accompanying drawings:—

Figure 1 is a partially schematic, vertical sectional view showing a corrosion-resistant metal cup and a right circular cylindrical billet of metal of high thermal conductivity inserted therein in accordance with a previously known method for producing a composite electrode.

Figure 2 is a sectional view showing a composite billet formed from the cup and billet of Figure 1.

Figure 3 is a sectional view showing an electrode blank having an upper headed portion and formed from the composite billet of Figure 2.

Figure 4 is a sectional view showing the electrode blank of Figure 3 positioned in a die having a stepped bore including an upper bore, a shearing shoulder, a second shoulder and a lower bore in accordance with the present invention.

Figure 5 is a partially schematic, vertical sectional view showing a composite centre electrode formed by shearing the upper headed portion of the electrode blank of Figure 4.

Referring now in more detail to the drawings, and, in particular, to Figure 4, a shearing and forming apparatus indicated generally at 28 comprises a die 29 having a stepped bore 30 including a right circular upper bore 31 extending to a shearing shoulder 32 of reduced diameter, a central bore below the shearing shoulder 32 and extending to a second shoulder 33, and a lower bore 34 extending from the second shoulder 33 through the die 29. The first step of the improved method involves inserting the electrode blank 25 within the stepped bore 30. When the electrode blank 25 is so inserted, the upper headed portion 24 seats on the shearing shoulder 32 and fits closely within the upper bore 31, while the lower portion 26 fits closely within the lower bore 34.

The shearing and forming apparatus 28 also comprises a plunger 35 having a diameter substantially equal to that of the shearing shoulder 32 and insertable therethrough, and a lower surface 36.

The next step of the method involves shearing and shaping the upper headed portion 24 of the electrode blank 25. The plunger 35 is inserted concentrically within the upper bore 31 against the upper headed portion 24 of the electrode blank 25. Pressure is then applied to the plunger 35 to force the upper headed portion 24 of the electrode blank 25 past the shearing shoulder 32, leaving a ring of excess material indicated at 37 in Figure 5, and against the second shoulder 33 to form a desired composite centre electrode indicated generally at 38 in Figure 5. The composite electrode 38 includes a head 39 and a rod 26' extending longitudinally therefrom and having a diameter equal to that of the lower portion 26 of the electrode blank 25. The electrode head 39 has an upper surface 40 conforming to the shape of the lower surface 36 of the plunger 35, a cylindrical side 41 having a diameter equal to that of the shearing shoulder 32, and an under surface 42 conforming to the shape of the second shoulder 33. Although the lower surface 36 of the plunger 35 is illustrated in Figure 4 as being concave, it can be of any shape necessary to form the upper surface 40 desired for the electrode head 39. The composite centre electrode 38 is then removed from the die 29 through the upper bore 31 and is suitable for the desired use without further cold-working or extruding steps.

CLAIMS

1. A method for producing a composite centre electrode for a spark plug, which method comprises the steps of forming a corrosion-resistant metal cup having a closed end, walls

extending upwardly from the closed end to an open end and a cavity extending concentrically therein, forming a composite billet having closed and filled ends by inserting into the open end of the cup a close-fitting right circular cylindrical billet of a metal having a high thermal conductivity and fitting tightly within the cup walls adjacent the closed cup end, but terminating short of the open cup end so that the cup walls extend thereabove at the open cup end, and by rolling the cup walls adjacent the open cup end radially inwardly, inserting the closed end of the composite billet into a die having a stepped bore including an upper bore in which the billet fits closely and an extrusion orifice of reduced diameter, forcing all except a terminal portion adjacent the filled end of the composite billet through the extrusion orifice to form an electrode blank having the unextruded terminal portion as an upper headed portion and a lower portion of reduced diameter extending longitudinally therefrom, removing the electrode blank from the bore, and shaping the upper headed portion of the electrode blank into a desired electrode head configuration to form the composite electrode; the improvement wherein the lower portion of the electrode blank is inserted into a die having a stepped bore including an upper bore in which the upper headed portion of the electrode blank fits closely, a shearing shoulder of reduced diameter equal to that of the desired maximum electrode head diameter, a second shoulder and a lower bore in which the lower portion of the electrode blank fits closely, and the headed portion of the electrode blank is then forced past the shearing shoulder and against the second shoulder to remove excess material from the head and to form the desired electrode head configuration in a single forming operation.

2. A method for producing a composite centre electrode for a spark plug substantially as described with reference to Figs. 4 and 5 of the accompanying drawings.